Mark Scheme (Results)

June 2017

IAL Chemistry (WCH06/01)
Chemistry Laboratory Skills II

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Summer 2017
Publications Code WCH06_01_MS_1706

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate’s response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate’s response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.
- Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:

  i) ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
  ii) select and use a form and style of writing appropriate to purpose and to complex subject matter
  iii) organise information clearly and coherently, using specialist vocabulary when appropriate

Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:
- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/ means that the responses are alternatives and either answer should receive full credit.
( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
Phrases/words in **bold** indicate that the <u>meaning</u> of the phrase or the actual word is **essential** to the answer.
ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Quality of Written Communication
Questions which involve the writing of continuous prose will expect candidates to:
- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Question Number	Acceptable Answer	Reject	Mark
1(a)(i)	(Green solid) turns black OR Black solid formed ALLOW crystals / precipitate / powder for solid **(1)** Colourless liquid (condenses at the mouth of the boiling tube) ALLOW steamy fumes / steam / white fumes / condensation **(1)** IGNORE Gas / vapour evolved Effervescence /bubbling / fizzing Water / water vapour formed	White gas	**(2)**

Question Number	Acceptable Answer	Reject	Mark
1(a)(ii)	**EITHER** Add (water) to cobalt((II)) chloride /$CoCl_2$ (paper) **(1)** (cobalt chloride) turns (from blue to) pink **(1)** **OR** Add (water) to **anhydrous** copper((II)) sulfate / $CuSO_4$ **(1)** (copper(II) sulfate) turns (from white to) blue **(1)** **OR** Add (water) to copper((II)) sulfate / $CuSO_4$ **(1)** (copper(II) sulfate) turns from white to blue **(1)** If name and formula of reagents are given, both must be correct Ignore formula of product Observation mark dependent on test reagent being correct (or a near miss)	Boiling temperature is 100°C Test with litmus Test with universal indicator	**(2)**

Question Number	Acceptable Answer	Reject	Mark
1(a)(iii)	(Bubble the gas through) lime water / calcium hydroxide solution / $Ca(OH)_2(aq)$ **(1)** which turns milky / cloudy / chalky / forms white precipitate **(1)** If name and formula are given, both must be correct Observation mark dependent on test reagent being correct (or a near miss) IGNORE Extinguishes a lighted splint Blue litmus turns red	Smokey/turbid	**(2)**

Question Number	Acceptable Answer	Reject	Mark
1(b)(i)	Effervescence / bubbling / fizzing **(1)** IGNORE Gas / CO_2 / carbon dioxide evolved /steamy fumes (Green solid dissolves and) a blue solution formed **(1)**	Just 'turns blue' blue precipitate	**(2)**

Question Number	Acceptable Answer	Reject	Mark
1(b)(ii)	$Cu_2CO_3(OH)_2 + 2H_2SO_4 \rightarrow 2CuSO_4 + 3H_2O + CO_2$ OR multiples Ignore state symbols even if incorrect.		**(1)**

Question Number	Acceptable Answer	Reject	Mark
1(b)(iii)	(aqueous) Ammonia / $NH_3(aq)$) ALLOW NH_4OH / amine by name or formula IGNORE Dilute / concentrated		**(1)**

Question Number	Acceptable Answer	Reject	Mark
1(c)(i)	(Anhydrous) calcium chloride / $CaCl_2$ / magnesium sulfate / $MgSO_4$ / silica gel / sodium sulfate / Na_2SO_4 / calcium sulfate / $CaSO_4$ ALLOW Phosphorus(V) oxide / phosphorus pentoxide / P_4O_{10} / P_2O_5	NaOH / KOH / CaO / $CuSO_4$ / $CoCl_2$ / H_2SO_4 Just 'silica'	**(1)**

Question Number	Acceptable Answer	Reject	Mark
1(c)(ii)	Soda lime / sodium hydroxide / NaOH / potassium hydroxide / KOH ALLOW Calcium hydroxide / $Ca(OH)_2$	CaO / calcium oxide / any solutions Limewater	**(1)**

Question Number	Acceptable Answer	Reject	Mark
1(c)(iii)	Heat malachite solid /sample to constant mass OR Heat malachite, weigh and heat, re-weigh until two successive weighings are the same ALLOW No change in mass of malachite / test tube OR No change in mass of X / Y / U-tube(s) IGNORE No further change in colour No more gas / water produced	Just 'heat to constant mass'	**(1)**

Question Number	Acceptable Answer	Reject	Mark
1(c)(iv)	Mass of malachite / sample at the start OR Mass of residue/black solid/copper((II)) oxide after heating IGNORE Change in mass of malachite **(1)** **Change** in mass of solid **X and** solid **Y** OR Mass of **both** U tubes at the start **and** finish of the experiment **(1)** IGNORE Masses / amounts / moles of malachite Masses / amounts / moles of water and CO_2		**(2)**

(Total for Question 1 = 15 marks)

<table>
<tr><th>Question Number</th><th>Acceptable Answer</th><th>Reject</th><th>Mark</th></tr>
<tr><td>2(a)(i)</td><td>
<table>
<tr><th rowspan="2">Test</th><th colspan="3">Observations</th></tr>
<tr><th>pentanal</th><th>pentan-2-one</th><th>pentan-3-one</th></tr>
<tr><td>2,4-dinitro-phenyl-hydrazine</td><td>red / orange / yellow ppt</td><td>red / orange / yellow ppt</td><td>red / orange / yellow ppt</td></tr>
<tr><td>Tollens' reagent</td><td>silver mirror / black ppt / grey ppt</td><td>no change</td><td>no change</td></tr>
<tr><td>Iodoform test</td><td>no change</td><td>(pale) yellow ppt
OR
antiseptic smell</td><td>no change</td></tr>
</table>
2,4-DNPH tests

all three correct scores 2
ALLOW
two correct scores 1
three precipitates but no / incorrect colour scores 1
three 'solutions' scores zero (2)

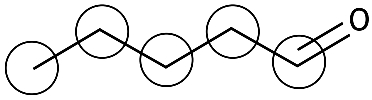
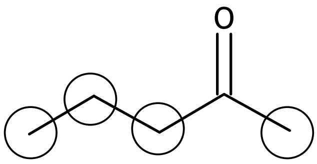
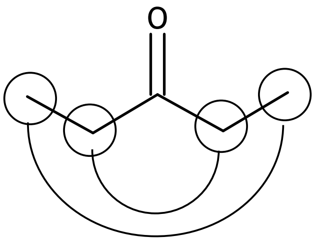
each other positive test scores 1 (2)

Penalise omission of ppt in Tollens' and iodoform tests once only

Four correct 'no change' scores 1 mark
IGNORE
Extra 'no changes' (1)
</td><td>solution for ppt

orange ppt</td><td>(5)</td></tr>
</table>

Question Number	Acceptable Answer	Reject	Mark
2(a)(ii)	The two methods must be marked separately **MP1 and MP2 Method 1** Iodine (solution) / I_2((aq)) / iodine in potassium iodide (solution) **(1)** Sodium hydroxide (solution) / NaOH((aq)) OR Potassium hydroxide (solution) / KOH((aq)) **(1)** **MP1 and MP2 Method 2** Add potassium iodide / KI((aq)) ALLOW Add sodium iodide / NaI((aq)) **(1)** Add sodium chlorate((I)) / sodium hypochlorite / NaOCl((aq)) **(1)** **MP3** MP3 is dependent on two correct reagents from a single method or on 'iodine and alkali' in method 1 Any indication that the inorganic reagents are in (aqueous) solution including "dilute" OR (Method 1 only) Add alkali to iodine until (brown solution) turns colourless OR Warm OR Heat in a water bath ALLOW Just 'heat' **(1)**	Just 'alkali' Ethanol as a solvent Reflux	**(3)**

<table>
<tr><th>Question Number</th><th>Acceptable Answer</th><th>Reject</th><th>Mark</th></tr>
<tr><td>2(b)</td><td>
<table>
<tr><th>Structure</th><th>Number of Proton Environments</th><th></th></tr>
<tr><td></td><td>5</td><td>(1)</td></tr>
<tr><td>
</td><td>4</td><td>(1)</td></tr>
<tr><td>
</td><td>2</td><td>(1)</td></tr>
</table>
If all three marks are not awarded
All three diagrams correct with correct linked proton environments scores 2
All three diagrams correct showing proton environments only scores 1
All three ‘numbers of proton environments’ correct scores 1 mark
ALLOW
any indication of identical environments in propan-3-one
</td><td></td><td>(3)</td></tr>
</table>

(Total for Question 2 = 11 marks)

Question Number	Acceptable Answer	Reject	Mark
3(a)(i)	(High resistance) voltmeter OR Potentiometer ALLOW high resistivity voltmeter	Low resistance voltmeter Galvanometer Voltmeter cell	**(1)**

Question Number	Acceptable Answer	Reject	Mark
3(a)(ii)	Copper / Cu	Cu^{2+} / Cu and any other metal	**(1)**

Question Number	Acceptable Answer	Reject	Mark
3(a)(iii)	Platinum / Pt		**(1)**

Question Number	Acceptable Answer	Reject	Mark
3(a)(iv)	Filter paper **(1)** IGNORE salt bridge (soaked in saturated solution of) potassium nitrate / KNO_3 ALLOW $NaNO_3$ / KCl / NaCl **(1)**	Just “paper” solids	**(2)**

Question Number	Acceptable Answer	Reject	Mark
3(a)(v)	Solution containing **soluble** iron(II) and iron(III) compounds identified by name or formula e.g. iron(II) sulfate / $FeSO_4$ **and** iron(III) chloride / $FeCl_3$ ALLOW Solution containing Fe^{2+} **and** Fe^{3+} **(1)** **Both** solutions 1 mol dm^{-3} in iron ions ALLOW Solutions equimolar in iron **ions** **(1)** Name or formula of **soluble** iron compounds **with** 1 mole of Fe^{x+} per mole of both compounds e.g. 0.5 mol dm^{-3} $Fe_2(SO_4)_3$ and 1.0 mol dm^{-3} $FeSO_4$ scores (2) marks If no other mark scored 1.0 mol dm^{-3} Fe^{2+} / Fe^{3+} OR 0.5 mol dm^{-3} $Fe_2(SO_4)_3$ **OR** 1.0 mol dm^{-3} $FeSO_4$ scores (1) marks		**(2)**

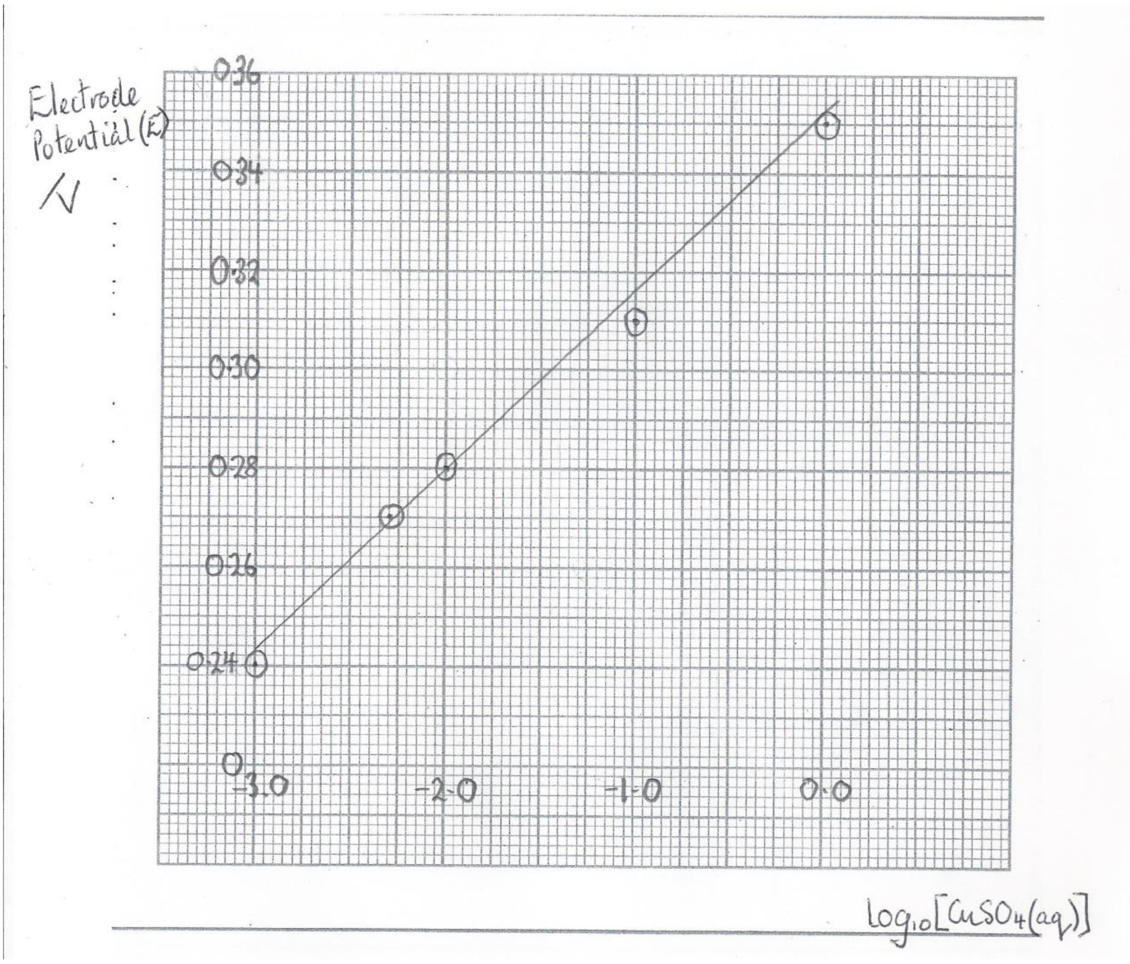
Question Number	Acceptable Answer	Reject	Mark
3(b)(i)	$2Fe^{3+} + Cu \rightarrow 2Fe^{2+} + Cu^{2+}$ OR Multiples OR $\rightleftharpoons$ for $\rightarrow$ IGNORE State symbols even if incorrect.	Reverse reaction Equations with uncancelled electrons	**(1)**

Question Number	Acceptable Answer	Reject	Mark
3(b)(ii)	(literature value) $E^{\ominus}_{cell}$ = 0.77 − 0.34 = (+)0.43 (V) TE on reverse reaction in (b)(i) ($E^{\ominus}_{cell}$ = −0.43 (V)) **(1)** % error = 100 x (0.43 − 0.35) ÷ 0.43 = 18.6 % TE on incorrect calculation of $E^{\ominus}_{cell}$ but literature value **must** be the denominator **(1)** IGNORE SF except 1 SF	22.9 % 20 %	**(2)**

Question Number	Acceptable Answer	Reject	Mark
3(c)(i)	**MP1** Use a **pipette** to measure 25.0 (or 10.0) cm^3 of the 1.0 mol dm^{-3} copper(II) sulfate solution ALLOW Burette **(1)** **MP2** Transfer this to a 250.0 (or 100.0) cm^3 volumetric / graduated / standard flask **(1)** **MP3** Make solution up to the mark with (distilled) water **and then** mix / shake / invert **(1)** If MP1 and MP2 not awarded, mention of pipette and volumetric flask scores 1	Measuring cylinder / beaker / syringe No mention of appropriate volume	**(3)**

Question Number	Acceptable Answer	Reject	Mark
3(c)(ii)	Increases the possibility of contamination of Cu^{2+} / $CuSO_4$ due to residues from earlier experiments in beakers or on salt bridge / electrodes ALLOW Reverse explanation i.e. low concentration to high reduces contamination risk		**(1)**

Question Number	Acceptable Answer	Reject	Mark
3(c)(iii)	See below for example Choice of scale to cover at least half the grid in both directions **and** labelled axes with units on y axis, which may be labelled E/V. x axis may be $\log_{10}[Cu^{2+}(aq)]$ or $\log_{10}[Cu^{2+}]$ or $\log_{10}[CuSO_4(aq)]$ or $\log_{10}[CuSO_4]$ **(1)** All points given in table correctly plotted TE on axes used **(1)** Any sensible smooth best fit **straight** line **(1)**	Non-linear scale scores (0) Any units on x-axis log scale reversed point to point line	**(3)**



Question Number	Acceptable Answer	Reject	Mark
3(c)(iv)	Electrode potential / E is proportional to $\log_{10}$ (concentration of copper((II)) ions) / $\log_{10}[Cu^{2+}((aq))]$ OR E ɑ $\log_{10}[Cu^{2+}((aq))]$ / $\log_{10}[CuSO_4((aq))]$ ALLOW log / lg for $\log_{10}$ IGNORE 'directly'/ reference to exponential relationships No TE on incorrectly plotted graph	E ɑ $[Cu^{2+}(aq)]$	**(1)**

(Total for Question 3 = 18 mark)

Question Number	Acceptable Answer	Reject	Mark
4(a)	Oxidising ALLOW “oxidising agent/liquid” “oxidatitve” / “oxidating” /”oxidant”	Flammable / inflammable	**(1)**

Question Number	Acceptable Answer	Reject	Mark
4(b)	Reaction (between concentrated nitric and sulfuric acid) is (very) exothermic ALLOW Generates a lot of heat IGNORE Vigorous / violent / prevents splashing / volatile To slow down the reaction / prevent high rise in temperature	Reaction between sulfuric acid and water To quench the reaction	**(1)**

Question Number	Acceptable Answer	Reject	Mark
4(c)	To minimise / prevent formation of 1-methyl-2,4-dinitrobenzene OR dinitration / trinitration / further substitution OR To ensure (only) monosubstitution IGNORE Further reactions occur		**(1)**

Question Number	Acceptable Answer	Reject	Mark
4(d)	To neutralise / react with / remove (remaining traces of / excess) acid / nitric acid / sulphuric acid IGNORE Impurities		**(1)**

Question Number	Acceptable Answer	Reject	Mark
4(e)	Lower value (from) 218-221 (°C) Upper value (to) 223-226 (°C)	222°C on its own or as one of the range values	**(1)**

Question Number	Acceptable Answer	Reject	Mark
4(f)	**Either** (Remove 1-methyl-4-nitrobenzene by) further distillation at (about) 240°C ALLOW between 238°C and 290 °C OR less than 300°C (and then recrystallisation / crystallisation from the distillation residue) **Or** Further distillation / fractional distillation **and** followed by recrystallisation / crystallisation from the distillation residue ALLOW Steam distillation **and** because 1-methyl-2,4-dinitrobenzene decomposes around its boiling temperature	Distillation at or above 300 °C	**(1)**

(Total for Question 4 = 6 marks)

TOTAL FOR PAPER = 50 MARKS

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